Lessons from the Bay

Journey of a Raindrop to the Chesapeake Bay

What path does a raindrop take when traveling from the schoolyard to the Chesapeake Bay, and what does it pick up along the way?

Objectives

Students will

- use political and topographic maps
- visualize flow from smaller tributaries to larger tributaries and discuss the journey of water from the schoolyard to the Chesapeake Bay
- observe schoolyard surfaces and direction of water flow and infer the polluting or non-polluting effects of those surfaces on rain runoff
- locate the schoolyard's place in the Chesapeake Bay watershed.

Background

When rain falls, it ends up in many places. Some rainwater is taken in by plants. Some seeps into the ground, where it replenishes groundwater supplies. Some rainwater gathers in puddles or closed ponds, where it may provide water for wildlife. The rest flows across the ground, pulled by gravity.

This water follows many paths, depending on local topography and development. Rainwater may flow into a stream, then into a larger stream or river. The water may flow through a wetland such as a bog, a marsh, a wet meadow, a shrub wetland, a tree swamp, or a stormwater management pond. A stream or river may flow through an open pond or lake that was formed by a beaver dam or a human-constructed dam. A natural stream's permeable surface, winding course, and vegetation help to slow the flow of water and filter out pollutants.

People affect the flow of water through their communities. Rainwater flows across pavement, where it picks up oil leaked from cars as well as litter and other pollution. In concrete gutters, channels, and storm sewers, water flows quickly and picks up pollutants. These manmade channels are often hot and dry between rains, and, as a replacement for natural streams, the channels provide an inhospitable habitat for wildlife.

Gravity pulls rainwater to lower and lower altitudes until it reaches sea level. Most of Virginia is in the Chesapeake Bay watershed, which

Related Standards of Learning

Science:
3.1.e; 3.9.c; 3.9.d; 3.10.b; 4.1.e; 4.8.a; 5.1.b; 5.1.c; 5.1.e; 5.7.f; 6.1.c; 6.1.d; 6.5.g; 6.7.a; 6.9.a

Mathematics:
3.14.a; 4.11.a; 5.11.a; 6.9.a

English:
3.1; 3.2; 3.4; 3.6.a; 3.6.b; 3.6.c; 3.6.d; 3.6.e; 3.6.f; 3.7; 4.1; 4.3; 4.5; 4.6; 5.1; 5.4; 5.6; 5.7; 6.1.a; 6.3; 6.5.a; 6.5.b; 6.5.c; 6.5.d; 6.5.e

History and Social Science:
3.6; VS.1.b; VS.1.d; VS.1.h; VS.1.i; USI.1.e; USI.1.f; USII.1.f

Time Required

Four sessions (30, 45, 25, and 45 minutes)

Materials

- Raindrop to the Bay *presentation, by Kathy Woodard (see Resources)*
- *computer with large monitor or projection device*
- *large map of Virginia*
- *dictionary*
- *Internet access*

For each student:

- On the Way to the Chesapeake Bay: The Journey of a Raindrop *(booklet follows this lesson plan, pages 9–14)*

For each group:

- *small map of Virginia (from textbook or other source)*
- *enlarged topographic maps from* Virginia Atlas and Gazetteer:
  - *Brackett Farm, Louisa County (bottom right corner of p. 68)*
  - *your local area including first major tributary*
- *tennis ball*
- *highlighter*
- *paper and pencil*
- *clipboard (optional)*

means the water in its streams, rivers, open ponds and lakes, and even storm drains will enter the Chesapeake Bay. There are four major rivers that flow into the Chesapeake: the Potomac, the Rappahannock, the York, and the James. Each river is surrounded by land that drains into the river; this area is considered the river's watershed. These watersheds combine with the others that drain into the Bay to make the larger Chesapeake Bay watershed.

Even if your school is outside the Chesapeake Bay watershed, your students will benefit from this lesson. Whatever your watershed, the concepts in the lesson are the same.

In this lesson, students will use maps to determine the path a raindrop follows from the schoolyard to the Chesapeake Bay. (See "Using Maps" on page 51 of the **Project Action Guide**.) They will record their findings in the form of a "watershed address." A mailing address lists a house number, street, town, and state and conveys a location based upon manmade boundaries. A watershed address lists the streams, rivers, and Bay to identify a location based upon the flow of water. Both list information in order from smallest to largest. A watershed address may be long or short, depending on the path water takes to reach the Bay. Here are examples of both:

Mailing address:	Lake Anna State Park 6800 Lawyers Road Spotsylvania, Virginia 22553
Watershed address:	Drainage ditch, Unnamed stream, Pigeon Run, Lake Anna, North Anna River, Pamunkey River, York River, Chesapeake Bay

Procedures

Session 1 (30 minutes)

Conduct this session in the classroom.

1. Read *On the Way to the Chesapeake Bay: The Journey of a Raindrop* together.
2. After reading, return to each page and discuss what the raindrop might "pick up" and carry with it from each stop on its journey. Draw a large raindrop on the chalkboard or chart paper. As students list what is picked up, write each item on the raindrop. Students may also draw these items on their copies of the story or draw on each page a raindrop with the items it has gathered.
3. Discuss which of the items on the raindrop could cause harm to the water quality of the Bay.

Session 2 (45 minutes)

Conduct this session in the classroom.

1. Prepare to show the *Raindrop to the Bay* multimedia presentation on a large monitor or with a projection device. Introduce the presentation by explaining that it follows a group of teachers as they travel the path that water takes from Louisa County to the Chesapeake Bay. After watching this journey, students will map out the path that water takes from the schoolyard to the Bay.
2. Divide students into map groups. Each group will need a Virginia map, a map from the *Virginia Atlas and Gazetteer* that includes Brackett Farm, and a highlighter. Show students the location of Louisa County on the large classroom map of Virginia. Have students locate it on their maps of Virginia.
3. Direct students to work together while watching the presentation to follow on the Virginia maps the journey from the Pamunkey River to the York River to the Bay.
4. During the presentation, take special note of the slide entitled "What watershed are we a part of?" Students will use this EPA Web site later in the lesson to locate their watershed. Tell students to pay particular attention to the process of clicking Virginia within the U.S. map, then a local region of Virginia on the next slide.
5. At the slide entitled "Brackett Farm's Watershed Address," use a map showing Brackett Farm and the South Anna River to see how the path of the water determines the watershed address. Help students locate Brackett Farm (Nolting Pond is on the farm), and tell them to indicate the farm's location with a star. Then, direct students to follow the water's path with a highlighter on the *Virginia Atlas and Gazetteer* map as the journey continues.

Session 3 (25 minutes)

Conduct this session in the schoolyard.

1. Ask students what might happen to a raindrop that falls in the schoolyard. Discuss various possibilities, and explain that the focus of this session is *runoff* (i.e., water that flows away).
2. Ask for a volunteer to look up the word *topography* in the dictionary. Discuss the definition, and explain that students will be looking at the topography of the schoolyard to determine which direction rainwater flows.
3. Divide the class again into their map groups, and make sure each group has a tennis ball and a clipboard (if available) with paper and pencil.
4. Tell students that they will have 5 minutes to walk around the schoolyard within your view. Groups should place their tennis ball in various locations around the schoolyard to observe how the ball is affected by gravity. Students then will use this information to determine which direction water will flow. Groups may record their data by drawing a map of the schoolyard and marking with arrows the direction the ball rolls and, thus, water will flow. (See "Mapping the Schoolyard" on page 53 of the **Project Action Guide**.) Tell students to include details about the surfaces over which rainwater will flow (e.g., grass, bare soil, pavement).
5. When the groups have completed their experiments, give them a few more minutes to analyze their data and extrapolate the likely route most of the rainwater will take to leave the schoolyard.
6. Call on a spokesperson for each group to share their findings. Discuss and decide as a class where the rainwater will go. If the area has storm drains, you may need to do additional research by contacting your city or county to find into which stream or river the storm drains empty.
7. Discuss the various surfaces rainwater flows over in the schoolyard and what effects the surfaces will have on the quality of the water that runs off. The following chart lists some possibilities.

Surface	What happens when water runs over	Effects on water quality
Large area of pavement	Water flows rapidly, causing increased erosion after leaving the pavement.	*Negative:* Erosion causes increased sediment pollution.
Parking lot	Water flows rapidly, causing increased erosion after leaving the pavement. Also water picks up oil and engine fluid deposited in the lot.	*Negative:* Erosion causes increased sediment pollution; automotive products contribute to toxic pollution.
Bare soil	Water erodes and carries away soil.	*Negative:* Erosion causes increased sediment pollution.
Mulch	Water travels slowly over bumpy mulch and soaks into the ground without carrying away soil.	*Positive:* Slower and reduced runoff decreases erosion and, therefore, decreases sediment pollution.
Grass	Water travels slowly over uneven surface and soaks into the ground, then roots take in water and hold soil in place. Grass can filter out harmful toxins.	*Positive:* Erosion and sediment pollution are further decreased; filtering decreases toxic pollution.
Forest	Water travels the most slowly in a forest. As it drips down through branches and leaves, much is taken in by trees and other forest plants' roots, which also hold soil. The forest has the most plants so it can filter out the most toxic pollution.	*Positive:* The slowest and cleanest runoff comes from forests. It has the least sediment pollution and the least toxic pollution when compared to other surfaces.

8. After discussing the effects of surfaces on runoff, have students add drawings and notes to their schoolyard maps to explain the effects of the different surfaces on the quality of water that leaves the schoolyard.

Session 4 (45 minutes)

Conduct this session in the classroom.

1. Display a Web browser on a large monitor or using a projection device, go to the EPA's *Surf Your Watershed* Web site (http://cfpub.epa.gov/surf/locate/index.cfm), and click "Search by Map." In the U.S. map, click Virginia. Then click your area of Virginia to find your local watershed.
2. Direct students to rejoin their map groups. Each group will need a Virginia map, an enlarged local topographic map from the *Virginia Atlas and Gazetteer* that includes your school, and a highlighter.
3. Instruct the students to find the school on the local topographic map and to draw an arrow showing the direction the class determined water would leave the schoolyard.
4. Instruct the students to find the stream nearest the point at which water leaves the schoolyard, then highlight the path from that stream to the stream or river into which it flows. (Topographic elevation lines are labeled in the *Virginia Atlas and Gazetteer* in light gray, and the water will flow from the higher elevation to the lower one. An alternative method is to find the larger tributary you know your area drains into and work backwards.)

   Students should continue to follow the water and highlight its path through all tributaries until it reaches the Bay.
5. As a class, review the water's path, listing the directions on the board as you go. This list of bodies of water between the schoolyard and the Bay provides the school's watershed address. Make sure to include in the address details the students noticed in the schoolyard, such as parking lots, sandboxes, athletic fields, gutters, and storm drains.
6. Follow the path of water from the schoolyard to the Bay, affixing a piece of string along its course on the large class wall map of Virginia. Have students help hold the string so that it follows the winding path of the streams and rivers as closely as possible. Cut the string when it reaches the Bay. Next lay the string straight on a table and measure it. Then use the map scale to convert the distance to kilometers or miles. This is the distance a raindrop travels from the schoolyard to the Chesapeake Bay.
7. Finally, have each student pretend he or she is a raindrop writing directions to another raindrop on how to get from the schoolyard to the Bay. Instruct students to include the elements of the school's watershed address as well as the distance from the schoolyard to the Bay. Encourage them to include things to look for along the trip, such as ground surfaces, land formations, and state parks.

Resources

Bour, Laura. *The River.* First Discovery Book. Paris: Gallimard Jeunesse, 1992. New York: Cartwheel Books-Scholastic, 1993. ISBN 0590471287.

"Building an Outdoor Classroom." Project Action Guide. *Lessons from the Bay*. 39–40.

Chesapeake Bay Foundation and Maryland Dept. of Natural Resources. "Going with the Flow." *Bay Grasses in Classes*. (See <http://www.cbf.org/site/PageServer?pagename=edu_educators_restoration_grasses>.)

Chesapeake Bay Foundation. "Your Virginia Watershed." *Watershed Action for Virginia's Environment (WAVE).* (See <http://www.cbf.org/site/PageServer?pagename=edu_educators_curriculum_va_index>, or contact the Virginia Office: Capitol Place, 1108 E. Main Street, Suite 1600, Richmond, VA 23219; phone 804-780-1392.)

"Mapping the Schoolyard." Project Action Guide. *Lessons from the Bay.* 53.

Ramsay, Helena. *Rivers and Lakes.* London: Children's Press of Grolier Publishing, 1997. ISBN 0516202375.

Telford, Carole, and Rod Theodorou. *Down a River.* Amazing Journeys. Heineman Library, 1998. ISBN 157721538.

United States. Dept. of the Interior. U.S. Fish and Wildlife Service. *Schoolyard Habitat Project Guide.* <http://www.fws.gov/r5cbfo/habitatguide.pdf>. (Chapter 3, "Wetland Habitat Project," includes "What Are Stormwater Management Ponds?" on page 78. For more information about the Schoolyard Habitat program, see <http://www.fws.gov/r5cbfo/schoolyd.htm>.)

United States. Environmental Protection Agency. *Surf Your Watershed.* <http://cfpub.epa.gov/surf/locate/index.cfm>.

"Using Maps." Project Action Guide. *Lessons from the Bay.* 51–52.

Virginia Association of Soil and Water Conservation Districts. "What's Your Watershed Address?" *Watershed Connections*. (See <http://www.vaswcd.org/eduprogs.htm>.)

Virginia Atlas and Gazetteer: topographic maps of the entire state, back roads and recreation areas. Delorme Mapping Company, 1995. (See <http://www.delorme.com/atlasgaz/>.)

Virginia. Dept. of Transportation. *2002–2004 Virginia Official State Transportation Map.* <http://virginiadot.org/comtravel/maps-state.asp>.

"Where Does Water Go?" *Let's Explore and Research Nature (LEARN).* (Environmental education lesson plans for field trips to Lake Anna State Park. Contact Lake Anna State Park: 540-854-5503.)

Woodard, Kathy. *Raindrop to the Bay.* Microsoft PowerPoint presentation. 2001. (See the Virginia Department of Education Web site at <http://www.pen.k12.va.us/VDOE/>. Also provided with the *Lessons from the Bay* CD.)

Classroom Assessment Suggestions

- *Map of schoolyard with correct flow directions and details about surfaces, including how surfaces will affect the quality of rainwater runoff*
- *Written directions to a fellow raindrop as described at the end of Session 4*

Extensions for Students

- *Take pictures with a digital camera (or scan 35mm photos) to make your school's own version of* Journey of a Raindrop to the Bay *multimedia presentation or picture book. Photos of the larger rivers can usually be found on the Internet by doing a search for the river's name or using picsearch.com on the Internet.*
- *At home, look around the yard to see where water would go. Make a list to create a personal watershed address.*
- *Use the rough sketch map of the schoolyard to create a more detailed topographic map of the same area.*
- *Read more about rivers, lakes, and other water bodies that water flows through on its way to the Chesapeake Bay in* The River, Down a River, *or* Rivers and Lakes.
- *Use a Virginia map and a copy of the W.A.V.E. Virginia's Chesapeake Bay Watersheds map to determine which river rainwater would flow into from these locations: Richmond, Fredericksburg, Waynesboro, Lake Anna, Arlington, Lexington, Winchester, Bowling Green, and Culpeper.*
- *See "Building an Outdoor Classroom" on page 39 of the* ***Project Action Guide****.*

On the Way to the Chesapeake Bay: The Journey of a Raindrop

Assembly Instructions

1. Print the booklet on back-to-back pages. (If your printer will not print back-to-back, you can tape page 2 to the back of page 1, page 4 to the back of page 3, etc.)
2. Fold the pages down the middle and staple together along the fold.